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COATED OXIDIZERS FOR STABILITY IN SPACE PROPULSION ROCKETS

While solid-propellant technology for rockets is maturing, some of the fundamentals of combustion have remained elusive, largely due to instability problems. Based on a JPL model for solid-propellant combustion, a concept of thermal performance modification to suppress instability was developed.

The thermal performance is tailored in any propellant by coating the oxidizer (typically ammonium perchlorate crystals) with a specially selected chemical. Polyvinyl alcohol is one of several candidates being tried for the coating, which represents about one percent by weight of the propellant. The coated-oxidizer concept for instability suppression is not unique, but the idea of tailoring thermal performance by coating is believed to be novel.

The tests in a simple L-star end-burning rocket motor indicate that the coating does suppress instability in certain regimes of pressure and L-star. Results also were confirmed in the more advanced microwave burner. In the low-frequency regime, the measured response function shows a lower value for the coated oxidizer than for the uncoated.

The concept was tested on several batches of ammonium perchlorate propellants in hydroxy-terminated polybutadiene binder systems. Nonmetallized propellants were used since instability occurs more often in such systems than in their metallized counterparts. The project is continuing to evaluate the optimum coats for different specific applications.

A scanning electron microscope (SEM) picture (magnification 1000x) showing an ammonium perchlorate (AP) crystal coated with 0.1 percent by weight of polyvinyl alcohol (PVA) for instability suppression through thermal performance modification. PVA is one of the several candidate chemicals tried for the coating.